Research Description

 You are to pick a problem (not necessarily the breaking edge of happening science) that you do not know the answer to, and do real scientific research on it. This is very different from the labs you have done in High School science. Your research must have an experimental aspect to it.

 Because experimental research takes a great deal of time, I want you to complete nearly all of your research the first semester. The second semester you will need to create a Web resource for your research project. Your grade the first semester will not be based on finding out some great truth of the Universe, but rather on the degree of effort and scientific thinking that you put in, and to a lesser degree, the quality of your presentation. Highly subjective criteria.

**These are my expectations:**

1. Pursue the unknown. We already know the knowns. Manipulate independent variables, measure dependents, and come up with intelligent reasons why what is happening is happening. Make and evaluate hypotheses.

2. Keep a research journal. It doesn't have to be neat - just think of it as a scientific diary. I put ideas and theories in mine. Most usually I write in it mundane things like what voltages correspond to melting ice and boiling water, what went wrong in the day's pursuit of the unknown, and what I need to try. I make little lists of problems I haven't solved so that I can come up with solutions as they occur to me. I also write down spontaneous brainstorms so that I don't forget them. I will read your research journal to form an opinion about your effort and scientific thinking.

3. Work on the research throughout the semester, and don't put it all off to the last minute. Expect to get a poor grade if you wait until the last moment, try something that doesn't work, and write about it.

 This project is a major part of your grade, and I expect you to pay attention to it accordingly. Because any experimental setup is wont to malfunction, you must start on this early so that you can get it working. To that end I will collect and enforce intermediate steps that will comprise your total grade as follows:

|  |  |
| --- | --- |
| Fall Semester | Spring Semester |
| Research proposal 5%Introduction 10%Working setup 10%Research defense 5%Final Paper 70% | (Evaluated as a whole according to a rubric that I will later share with you) |

**Fall Semester:**

•The **Research Proposal** should be a description of what your **topic** is, what **data** you hope to gather, what **method** and **setup** you plan to use to investigate it, and what **resources** you need.

•The **Introduction** to your final paper. A good introduction includes •**background information** about your topic logically organized from broad to narrow with citations, a concise •**description of the question** you are answering accompanied with your •**hypothesis**, (with •defined variables) and a •**bibliography** with at least five sources. Use your favorite method of citation and bibliography entry.

•For the **Working setup/Data** we will have a show and tell day. You need to **demonstrate** that you have a working setup and show us **a set of preliminary data, and an analysis of that data** from it.

•The **Research Defense** is a 10-15 minute talk in the evening about how you went about your research, what you discovered. A slide of your setup, and a graph of your data is all you really need.

•The **Final Paper** should follow the basic format for any scientific paper. (Introduction, method, results, discussion)

 The **method** is a detailed explanation of your **experimental setup**, and **how you gathered the data**. A nice method has **diagrams** or pictures of the setup, and the reasoning behind your experimental design. Write your method as paragraphs

 The **results** section has graphs of data and a discussion of the experimental uncertainty. It rarely contains all the raw data.

 The **conclusion** section talks about how the data did or did not support your hypothesis, additional hypotheses that may explain your data, and suggestions for further research. This will be the most fun section to write, even though it never was in the past. You will have something to write about this time.

Tips for Projects:

0. If you are taking the IB test in Physics, this is your IA, and you need to do a solo project. People can help you get your data, but all of the analysis, research, and writing needs to be your own.

1. Don't wait until the last moment to begin your project.

2. It doesn't have to be something really complicated.

3. I am more interested in your thinking than your breakthroughs

4. Brainstorm with other people.

5. Focus. Study "The wind erosion of sand behind rectangular shapes" rather than "Wind Erosion" or even "Erosion"

6. Don't worry about not knowing how something will turn out. If you knew how it would, it wouldn't be science.

7. Don't worry about coming up with some formula like every other part of physics. It may not happen, that's OK. I would love a paper even if it didn't have a single formula in it as long as it evidenced scientific thinking and observations.

8. I can help. Your classmates can help. You can even spend school money if I want to keep your experimental setup.

9. You can work in teams of up to two if you feel that each person can contribute something to the collaboration.

10. You can work on the same topic that another person or group is working on. Real science works this way.

11. You can replicate experiments that you have read about. Chances are you will branch off in some way, though.

12. Feel free to write well. Do not feel compelled to use passive voice. (Freedom should be felt regarding the efficacy of the use of proper and creative writing strategies. The use of passive voice is by no means compulsory, rather it is discouraged.) Don't use the word "impact" either. Effect a change that will affect the effect your writing has.

Random ideas

Viscosity vs temperature

Heat transfer at different fluid speeds

Temperature and conductivity

Conductivity of different concentrations of ions

Wave speed and water depth

Water depth and drag on a boat

Drag and wind velocity

Trebuchet counterweight vs range

High gravity plant growth

PSU drop tower -

Suspension of ping pong balls at different wind speeds

Newton's law of cooling

Eddy current damping

air bubbles and the speed of sound

Energy stored in batteries vs current

Pressure vs. muzzle velocity

Sound localization vs spectral density

Modeling a model rocket

Draw length vs arrow speed

Flow rate vs tube length vs hole diameter vs viscosity vs tube diameter

Temperature vs evaporation rate

Sweet spot of a bat - rebound velocity vs where the ball hits

Photovoltaic output vs temperature vs brightness

Power and heating efficiency

Voltage and motor speed